# Stratigraphic tests for palaeoenvironmental evolution in Eberswalde Crater: roadmaps to habitability

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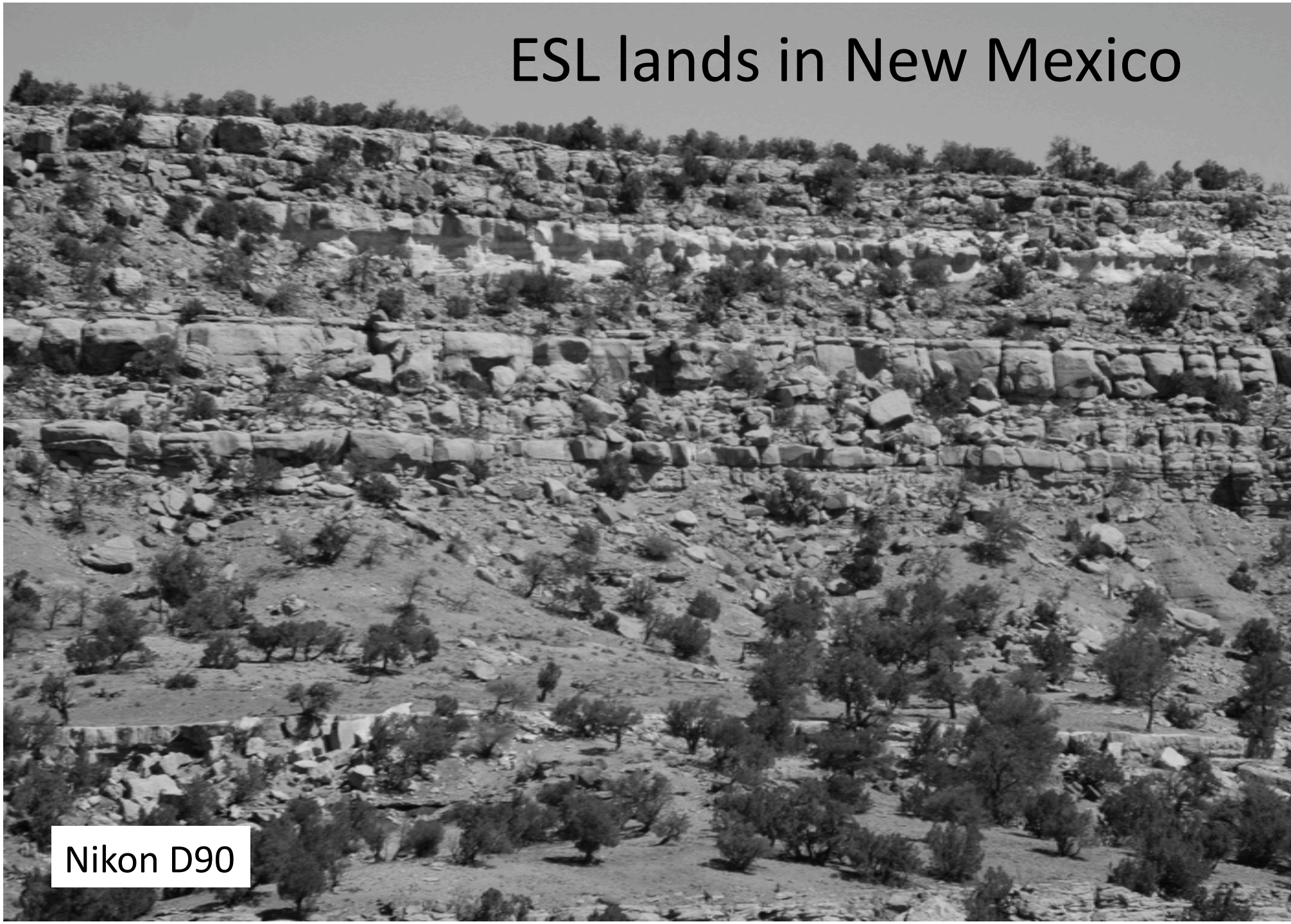
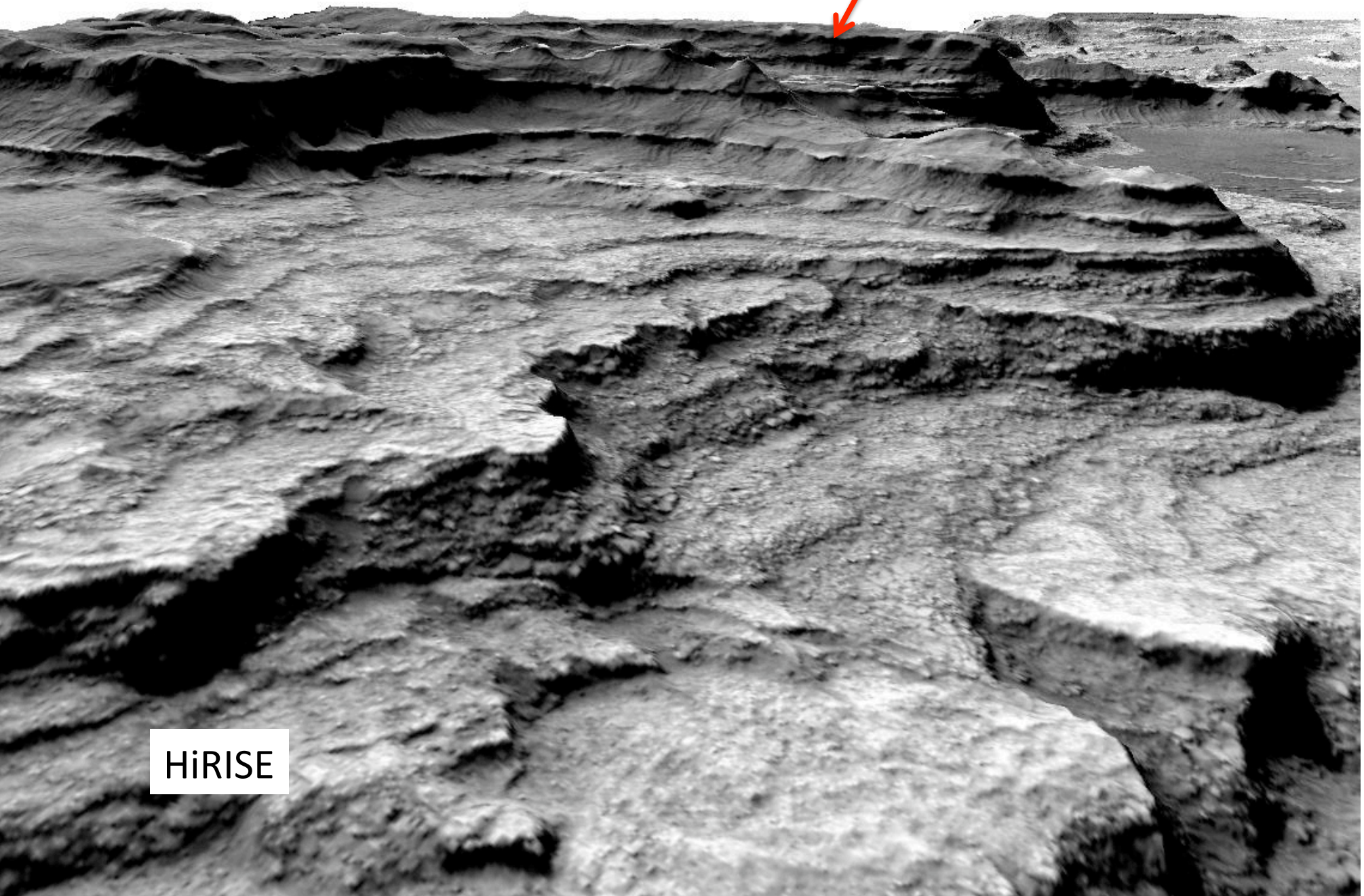

ESL lands in New Mexico
Nikon D90

# These rocks are fluvial!



# Hypothesis

- Eberswalde Crater geomorphology, stratigraphy and mineralogy record the evolution of a crater lake and associated fluvial-deltaic systems,
- and additionally represent a sedimentary, potentially habitable environment that is favorable to the preservation of organic materials.

# Hypothesis

*Process, Hydrology*

- Eberswalde Crater geomorphology, stratigraphy and mineralogy record the evolution of a crater lake and associated fluvial-deltaic systems,
- and additionally represent a sedimentary, potentially habitable environment that is favorable to the preservation of organic materials.

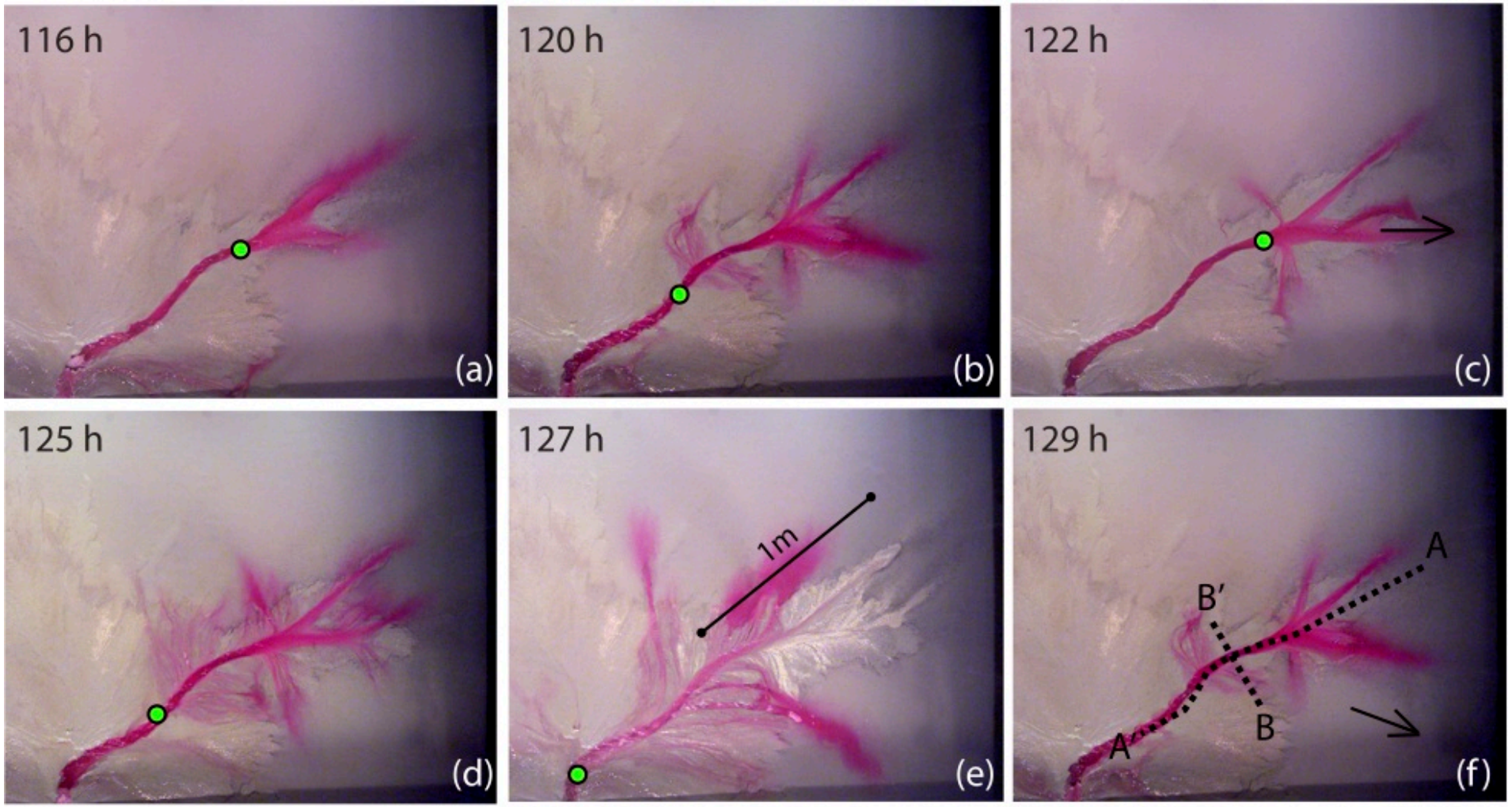
*Habitability*

*'Deltas' and 'fluvial channels' are sedimentological 'spectra' – they are tools to decipher hydrologic evolution*

*Delta tells us there was a lake*

*If there was a lake – then the lake beds are in the ellipse*

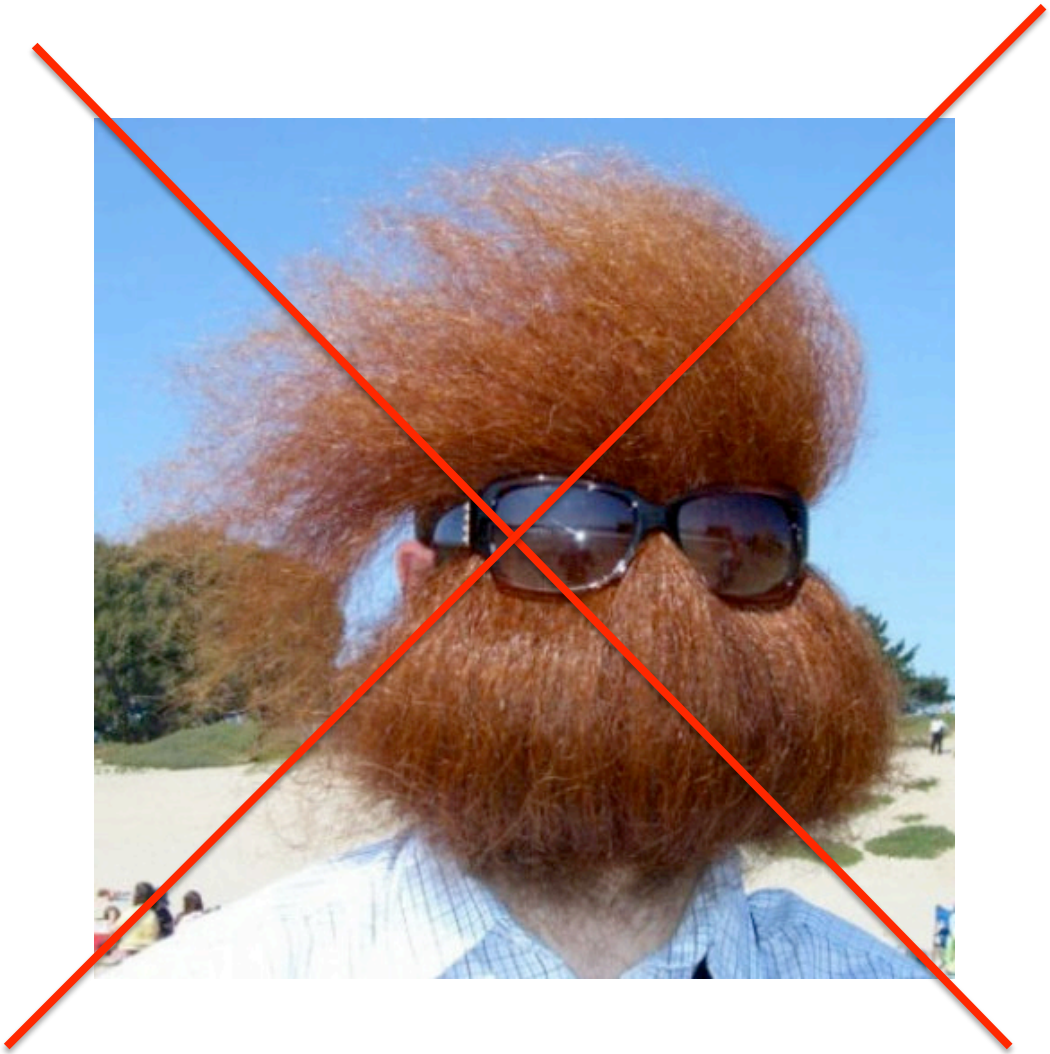
# Testable model: Fluvio-deltaic system prograding into a lake

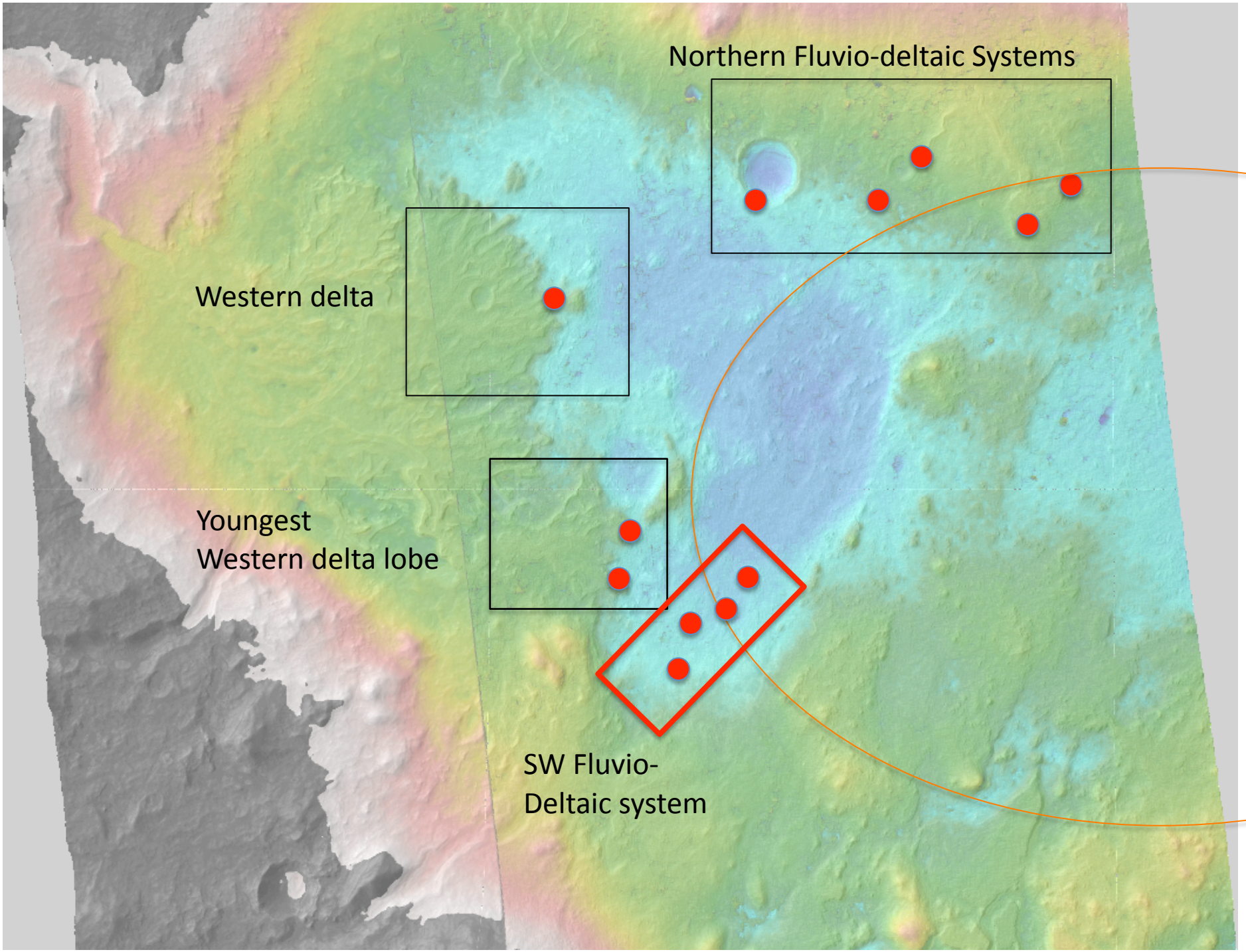


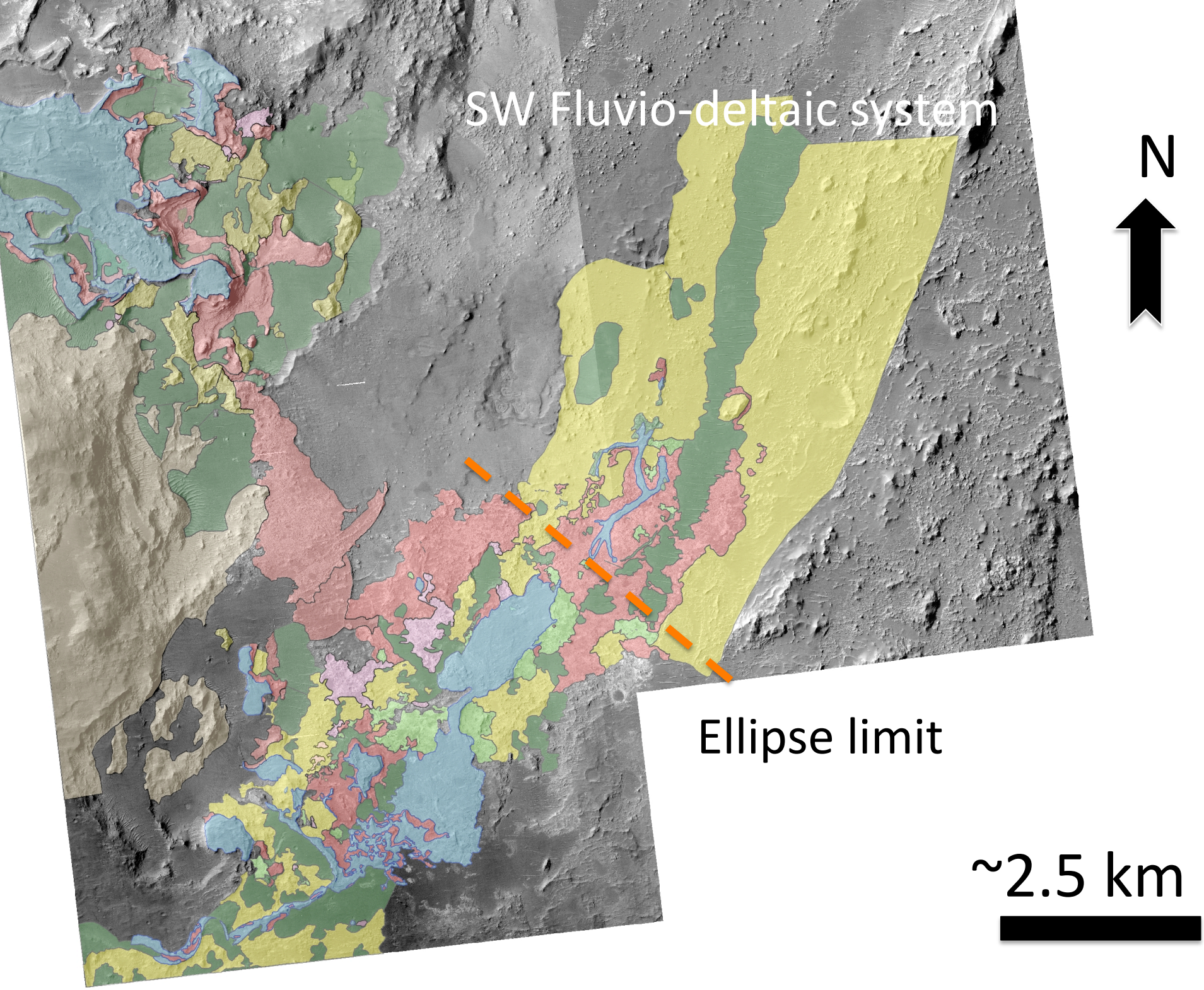

Made with EXXON secret sauce

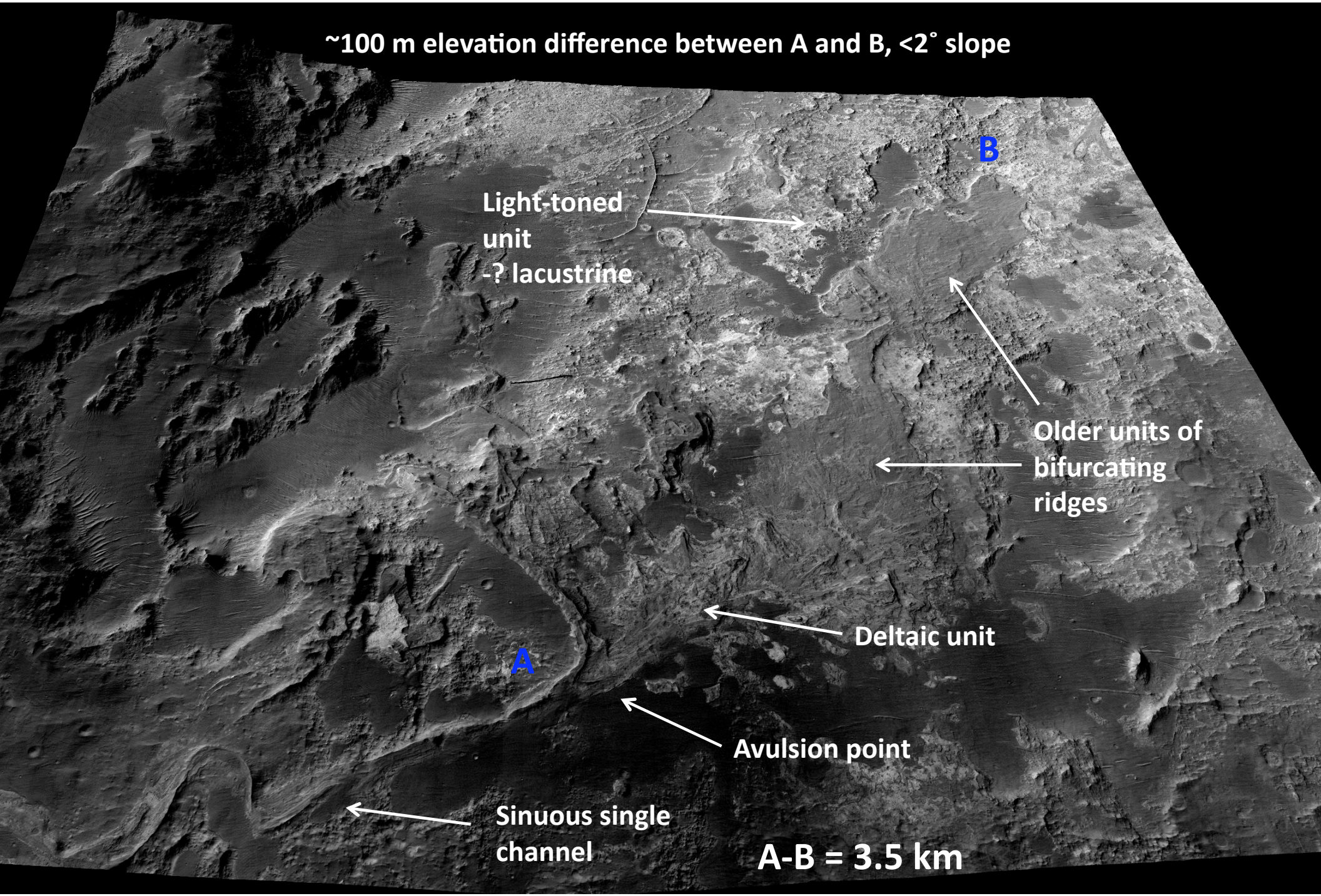
Hoyal and Sheets 2009

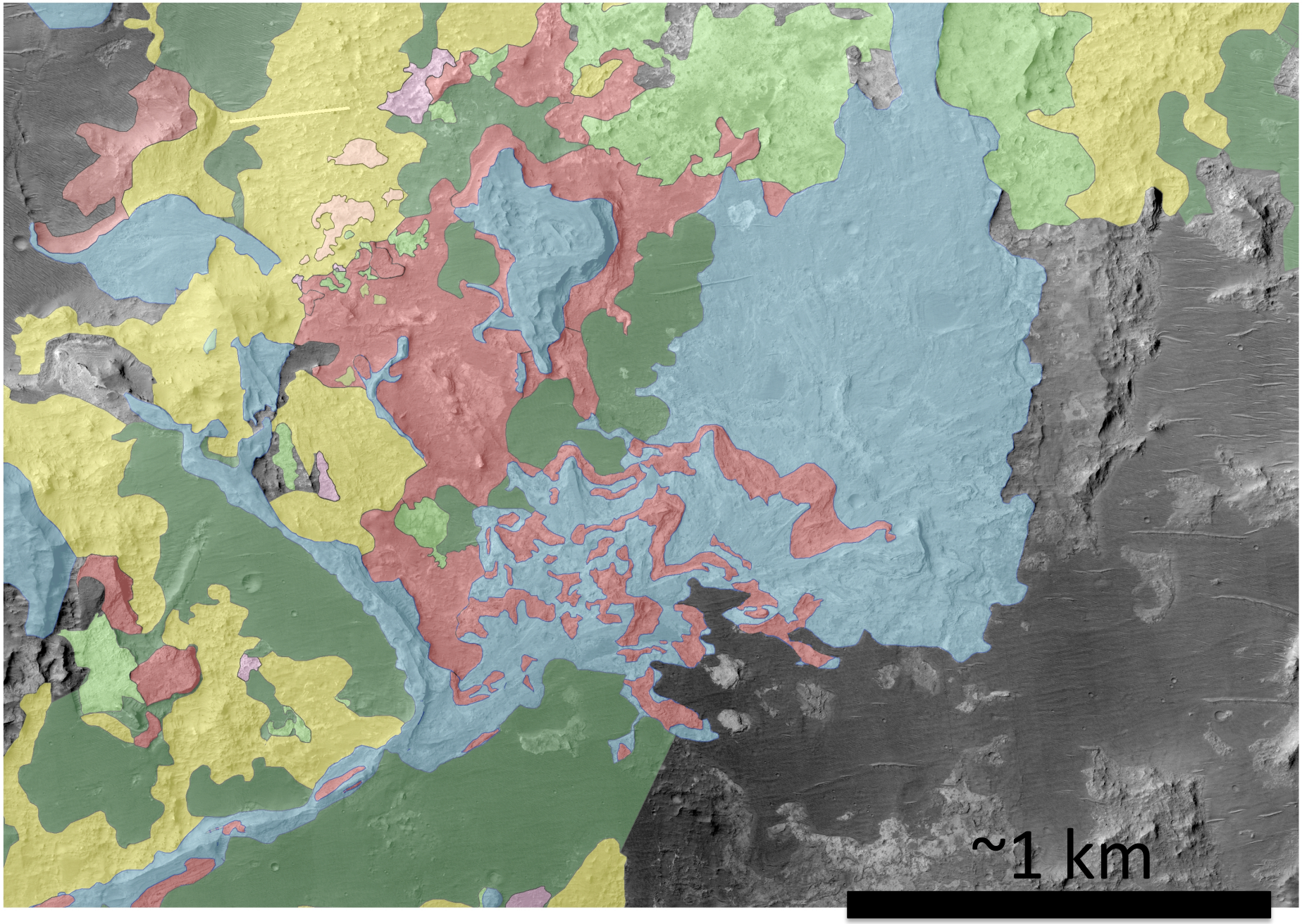
# Sanjeev's Razor – apologies to Ockham




Northern Fluvio-deltaic Systems
Western delta
Youngest
Western delta lobe
SW Fluvio-
Deltaic system

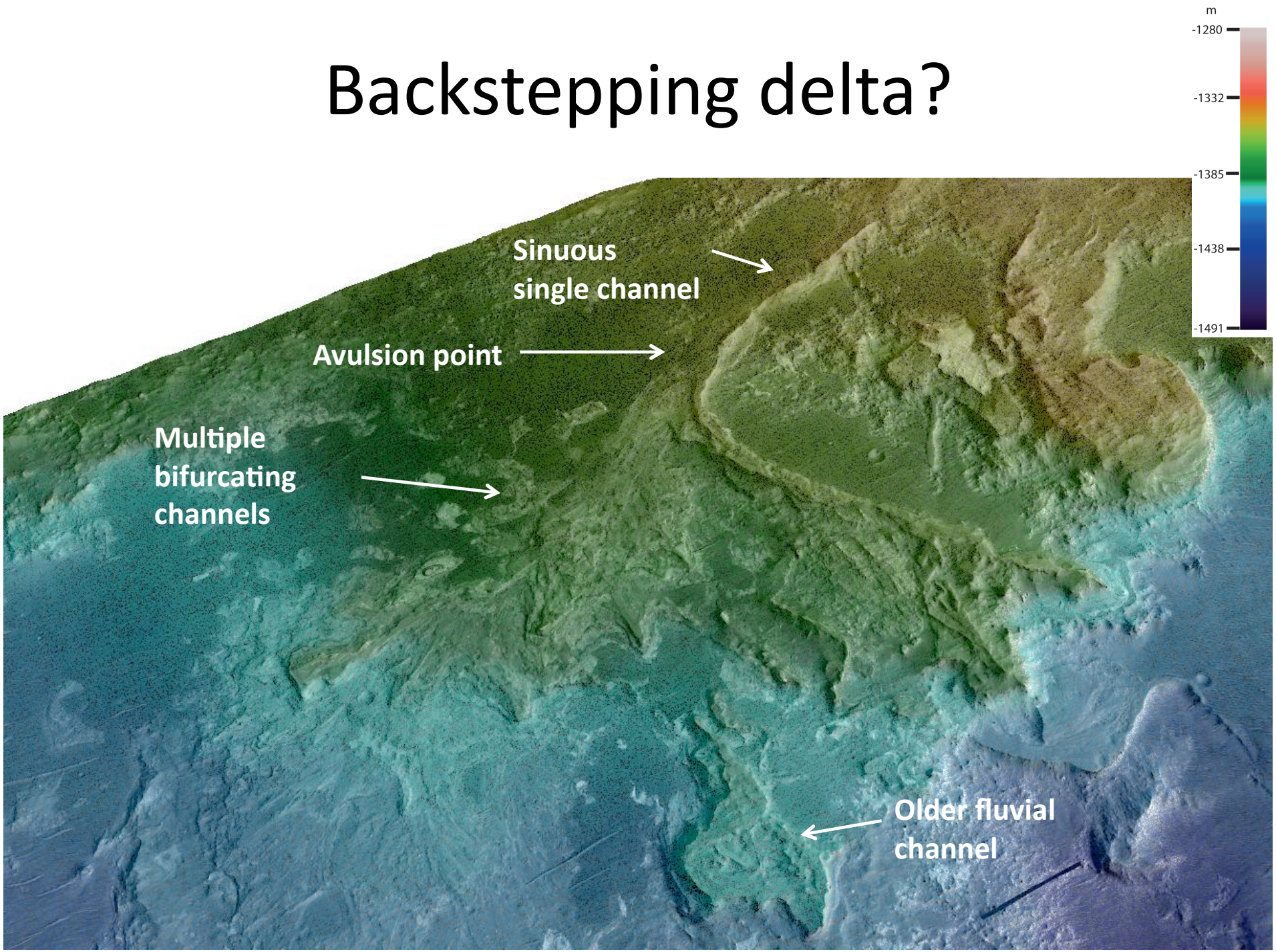

SW Fluvio-deltaic system
N
Ellipse limit
~2.5 km

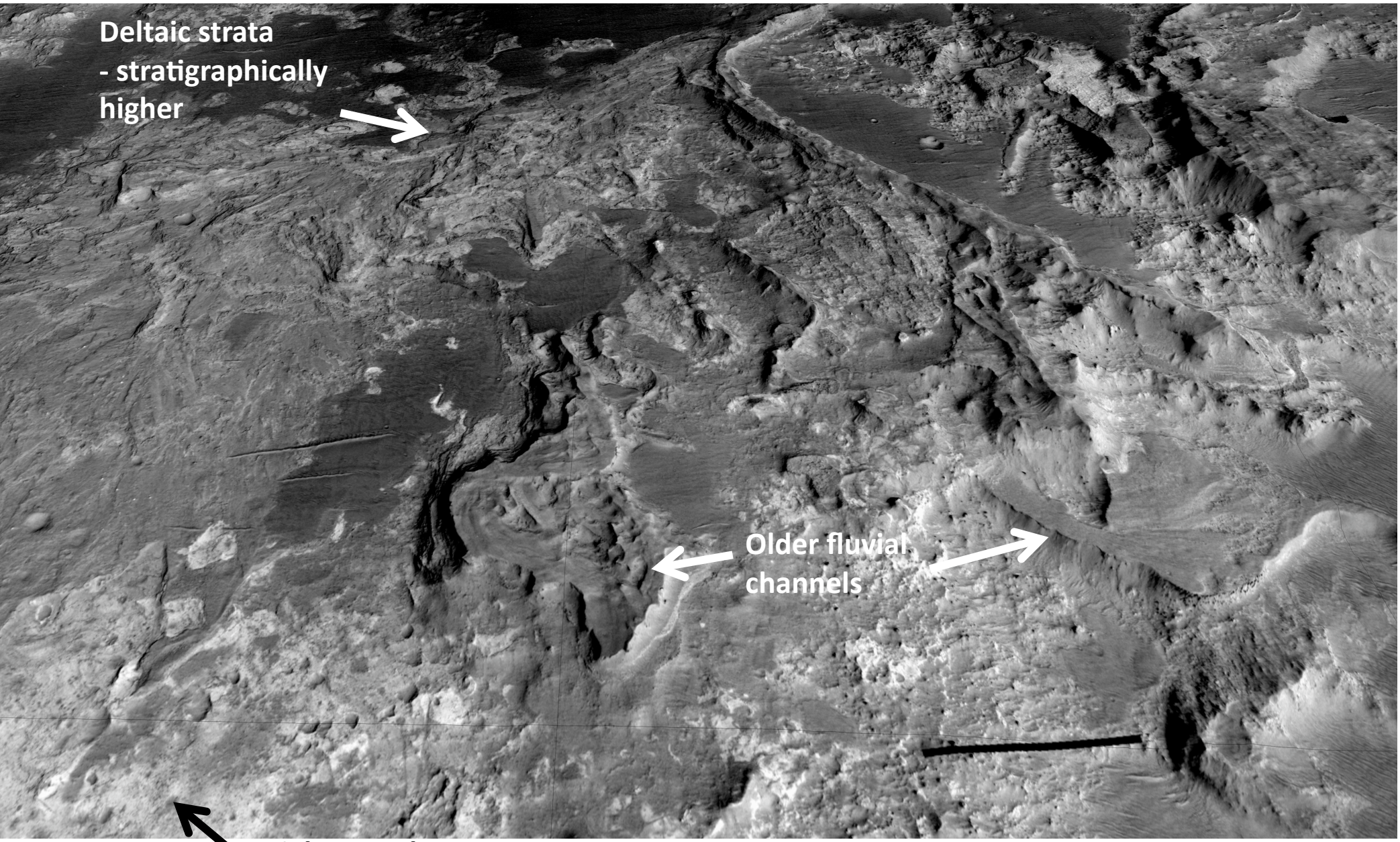

~100 m elevation difference between A and B, <2˚ slope
B
Light-toned unit -? lacustrine
Older units of bifurcating ridges
Deltaic unit
A
Avulsion point
Sinuous single channel
A-B = 3.5 km

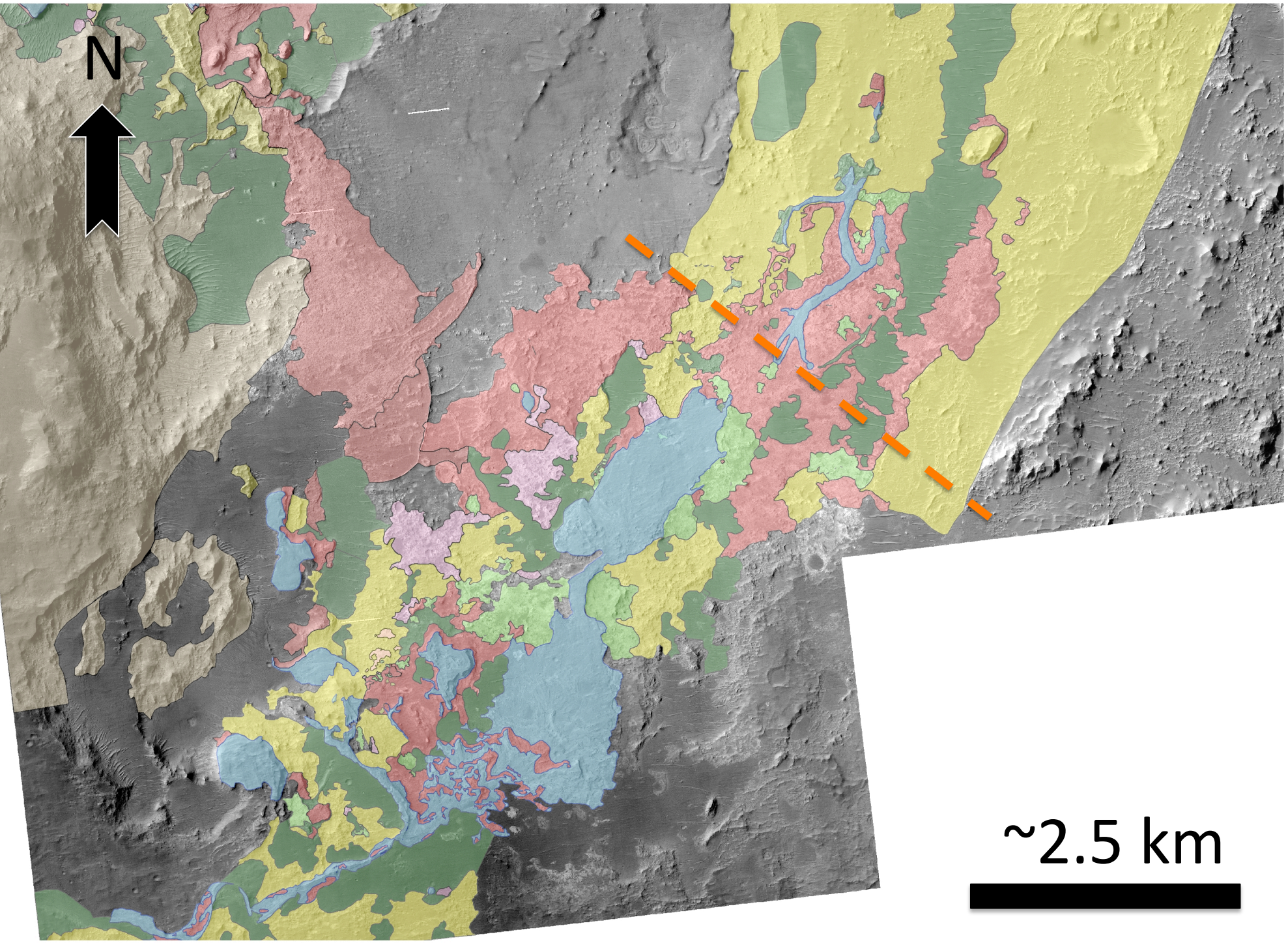

~1 km

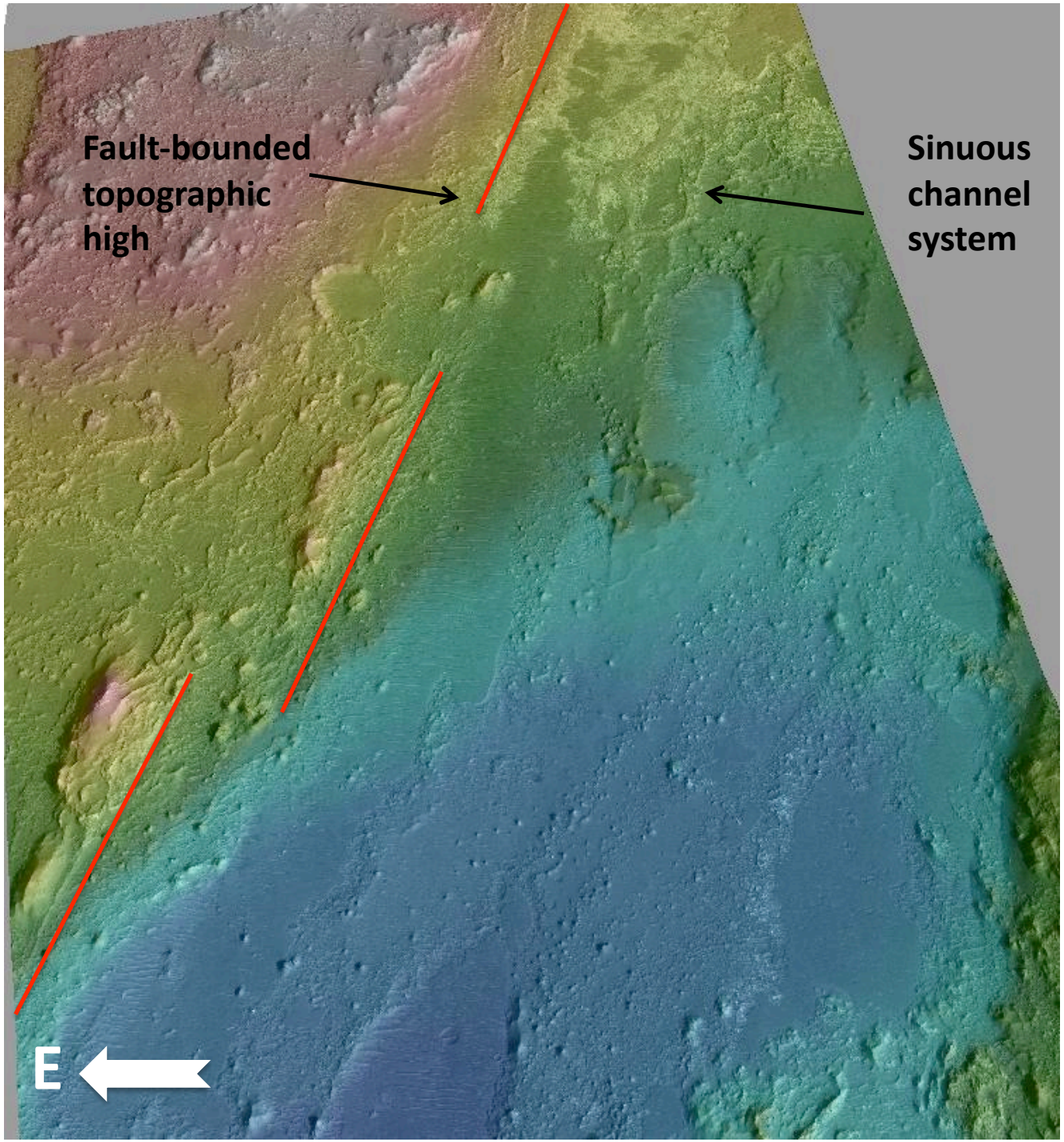
d
unit

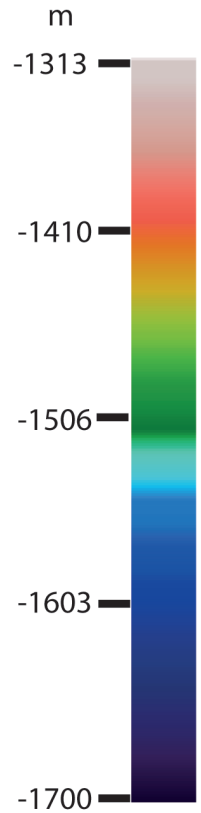
# Backstepping delta?



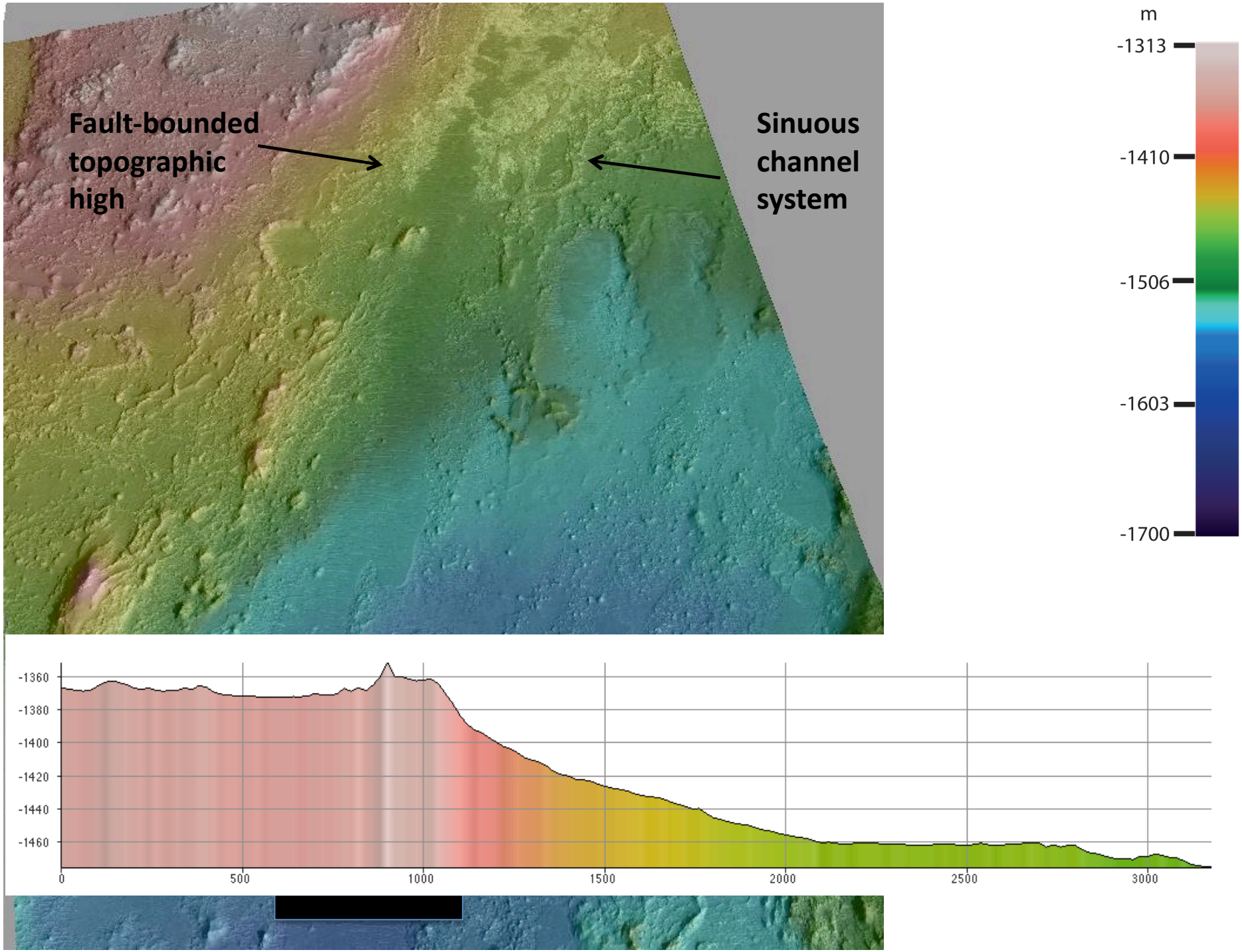

Deltaic strata
- stratigraphically
higher
Older fluvial
channels
Light toned
fractured unit


N
~2.5 km

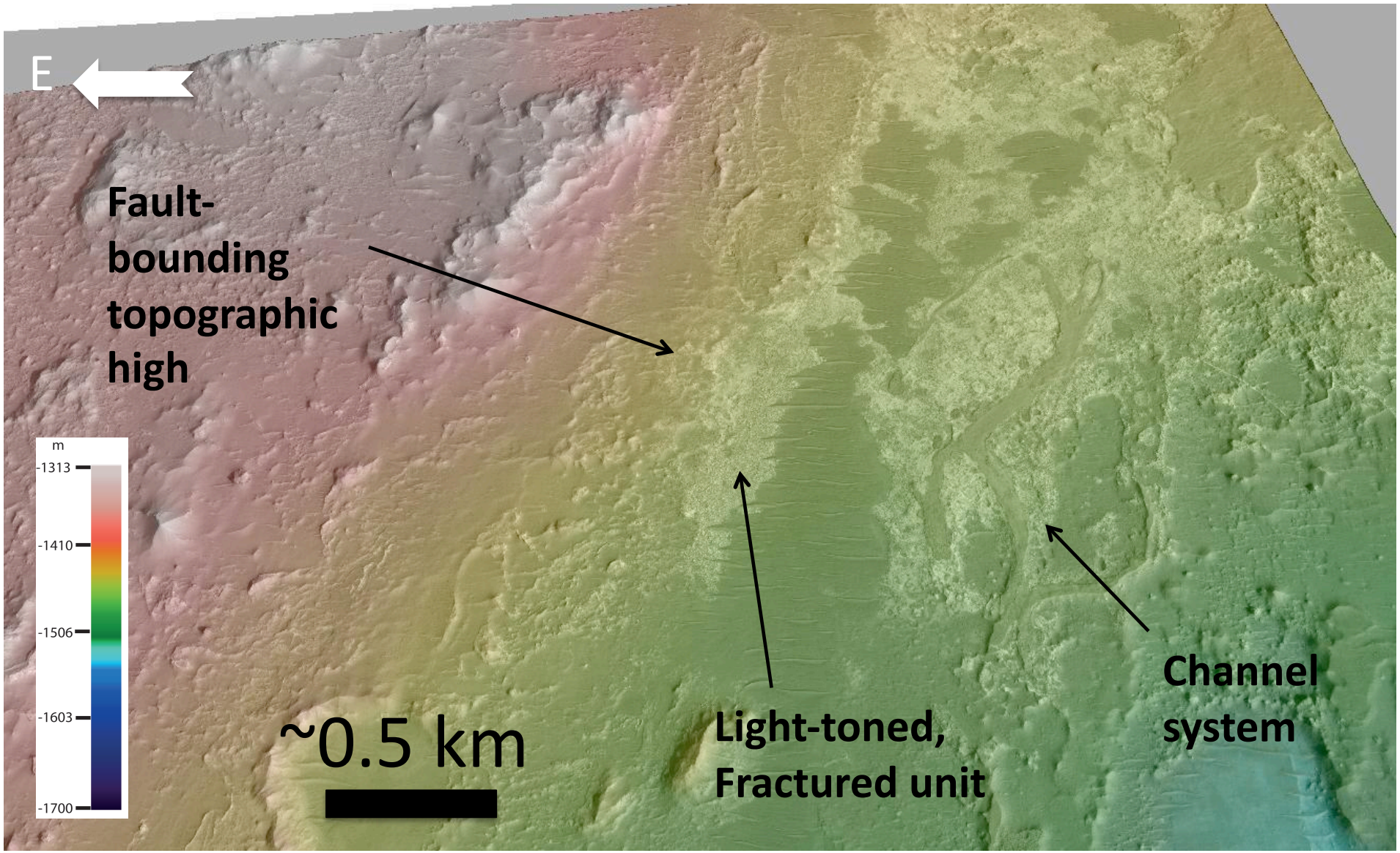

Fault-bounded topographic high
Sinuous channel system
E

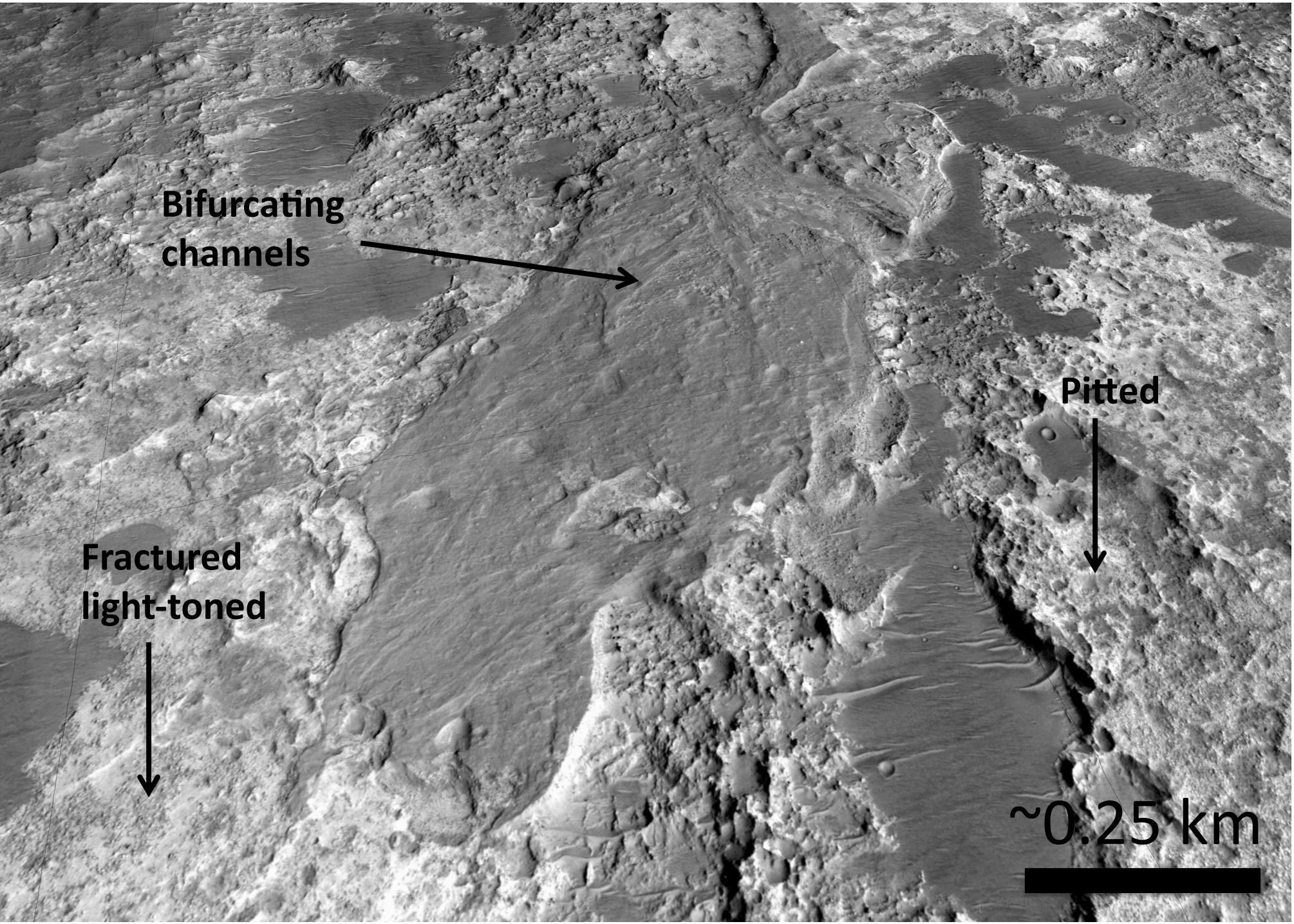

m
-1313
-1410
-1506
-1603
-1700

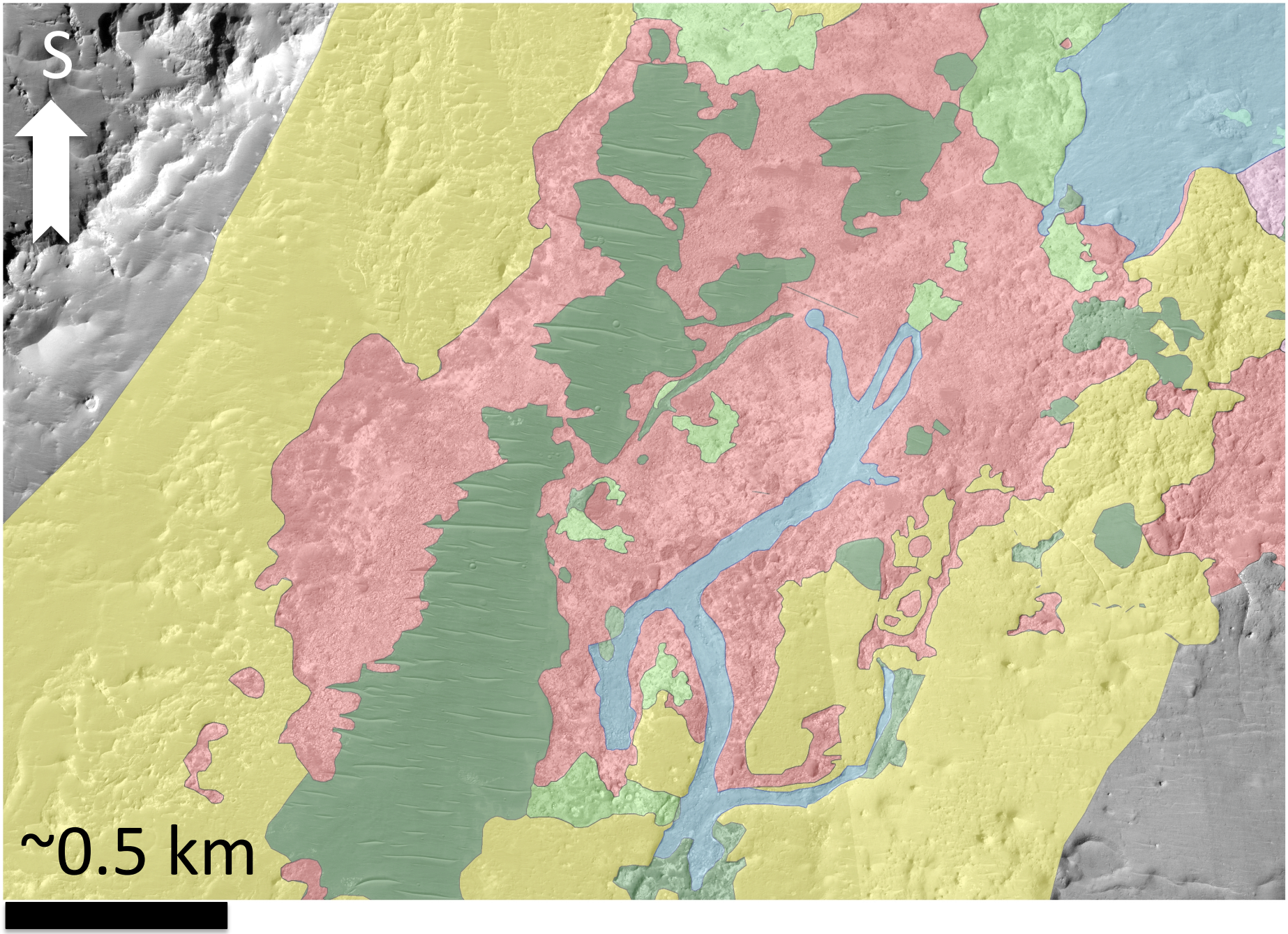
~1 km

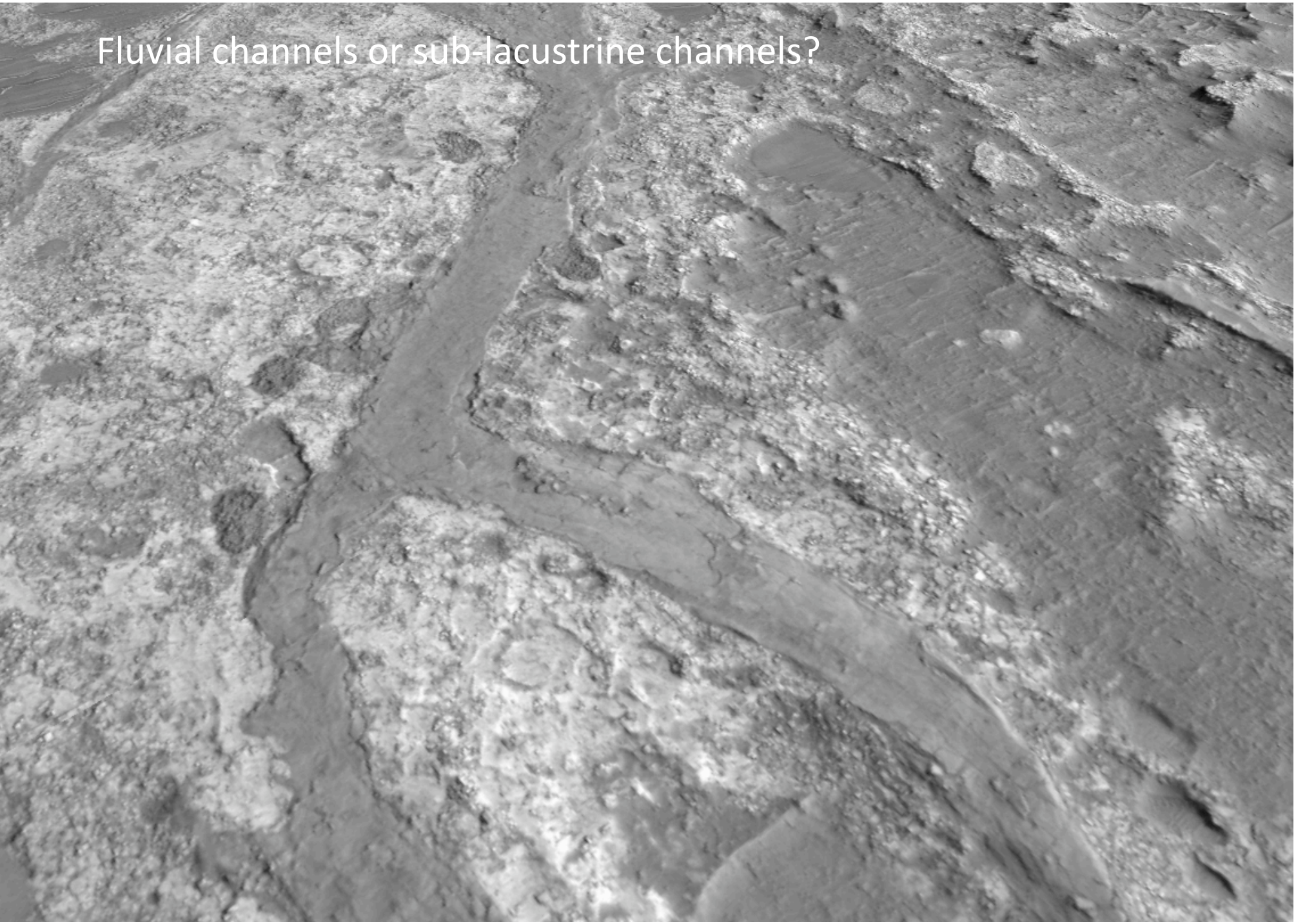

Fault-bounded topographic high
Sinuous channel system
m
-1313
-1410
-1506
-1603
-1700
-1360
-1380
-1400
-1420
-1440
-1460
0
500
1000
1500
2000
2500
3000

# Distal system




Bifurcating channels
Pitted
Fractured light-toned
~0.25 km

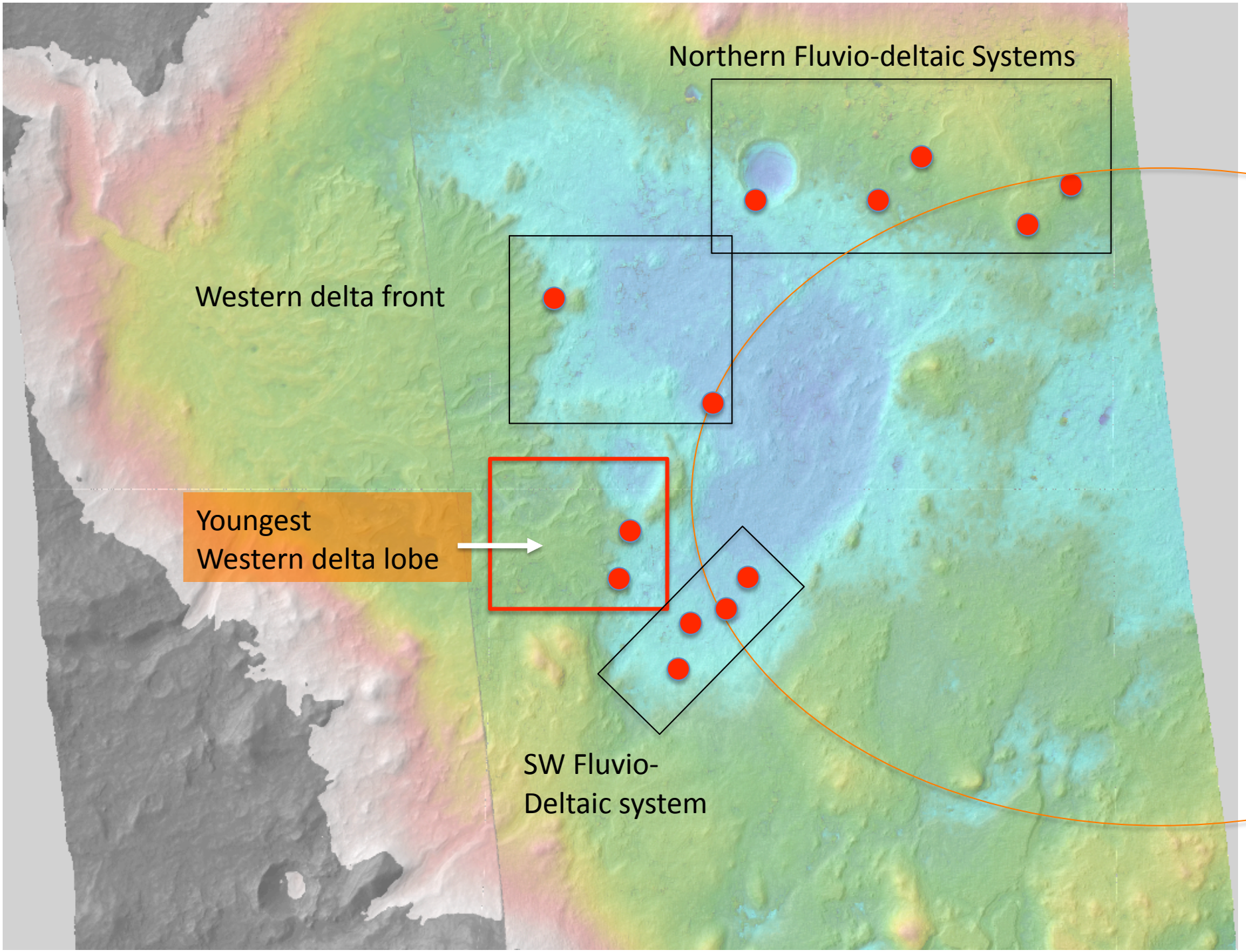

S
~0.5 km


Fluvial channels or sub-lacustrine channels?

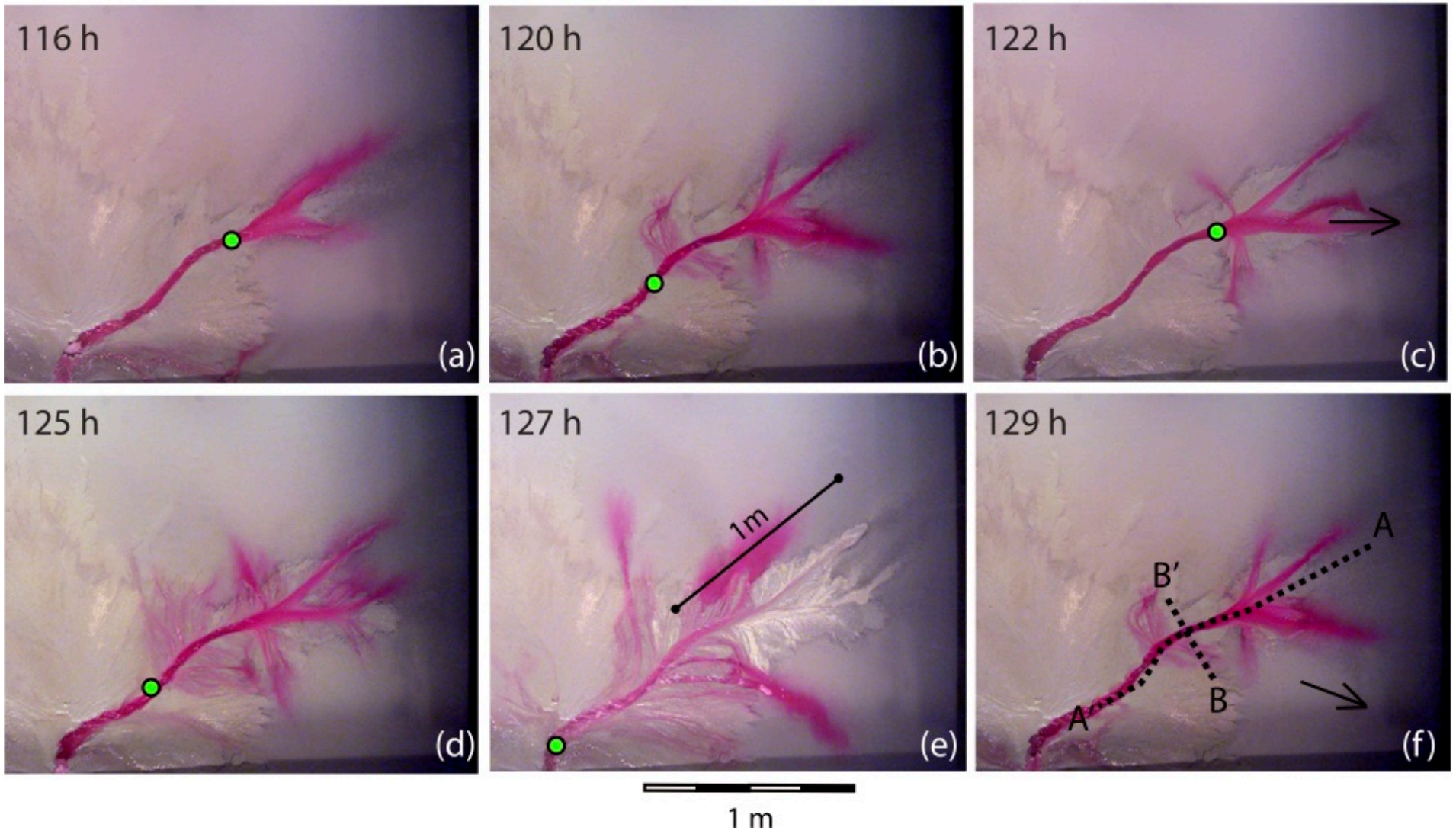
# SW Delta system

- Permits characterization of system over ~8-10 km of depositional dip length
- Shows complex interfingering of fluvial, deltaic and basinal facies
- Different system evolution to main delta

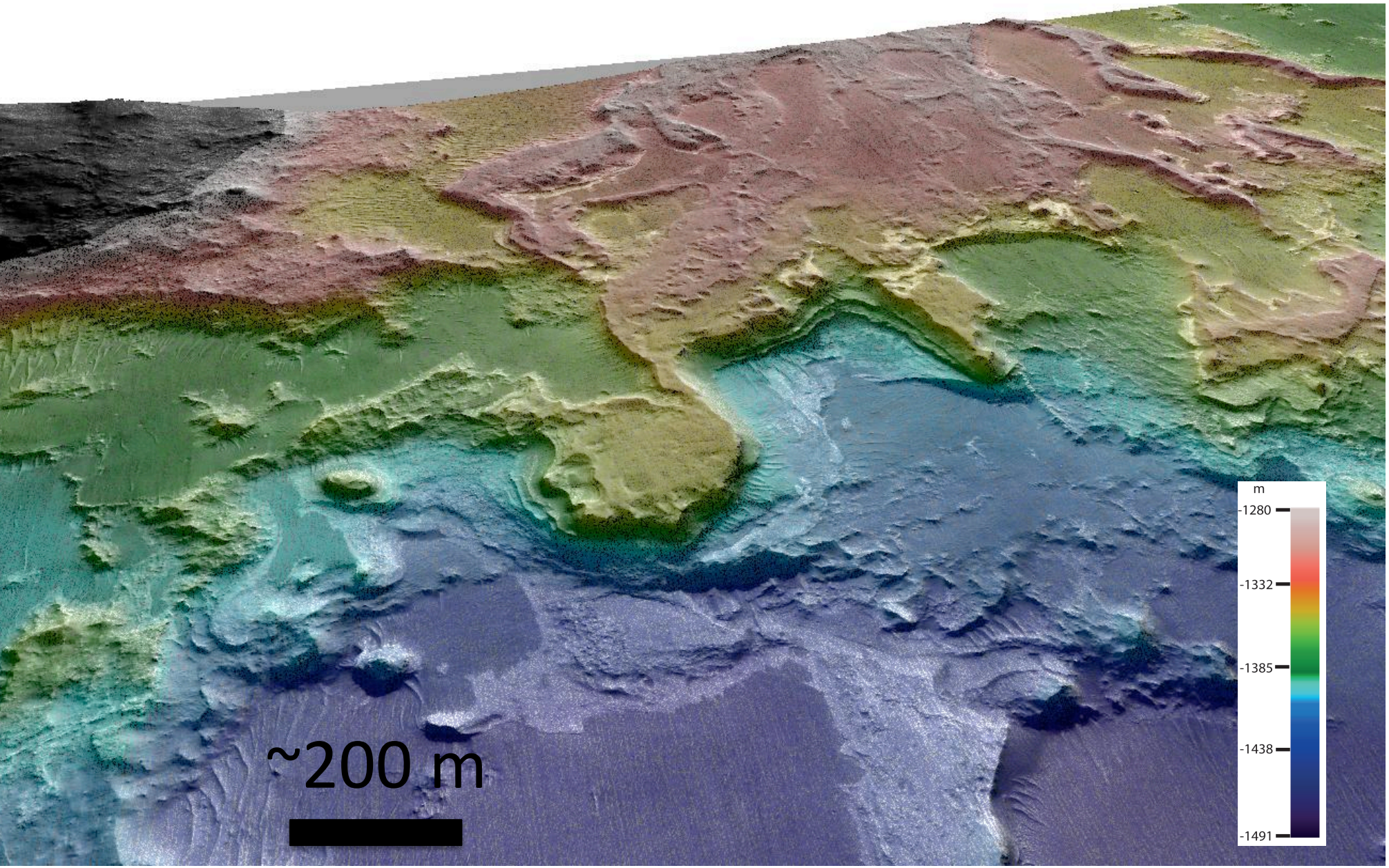
Offers the potential to compare and contrast to understand basin evolution

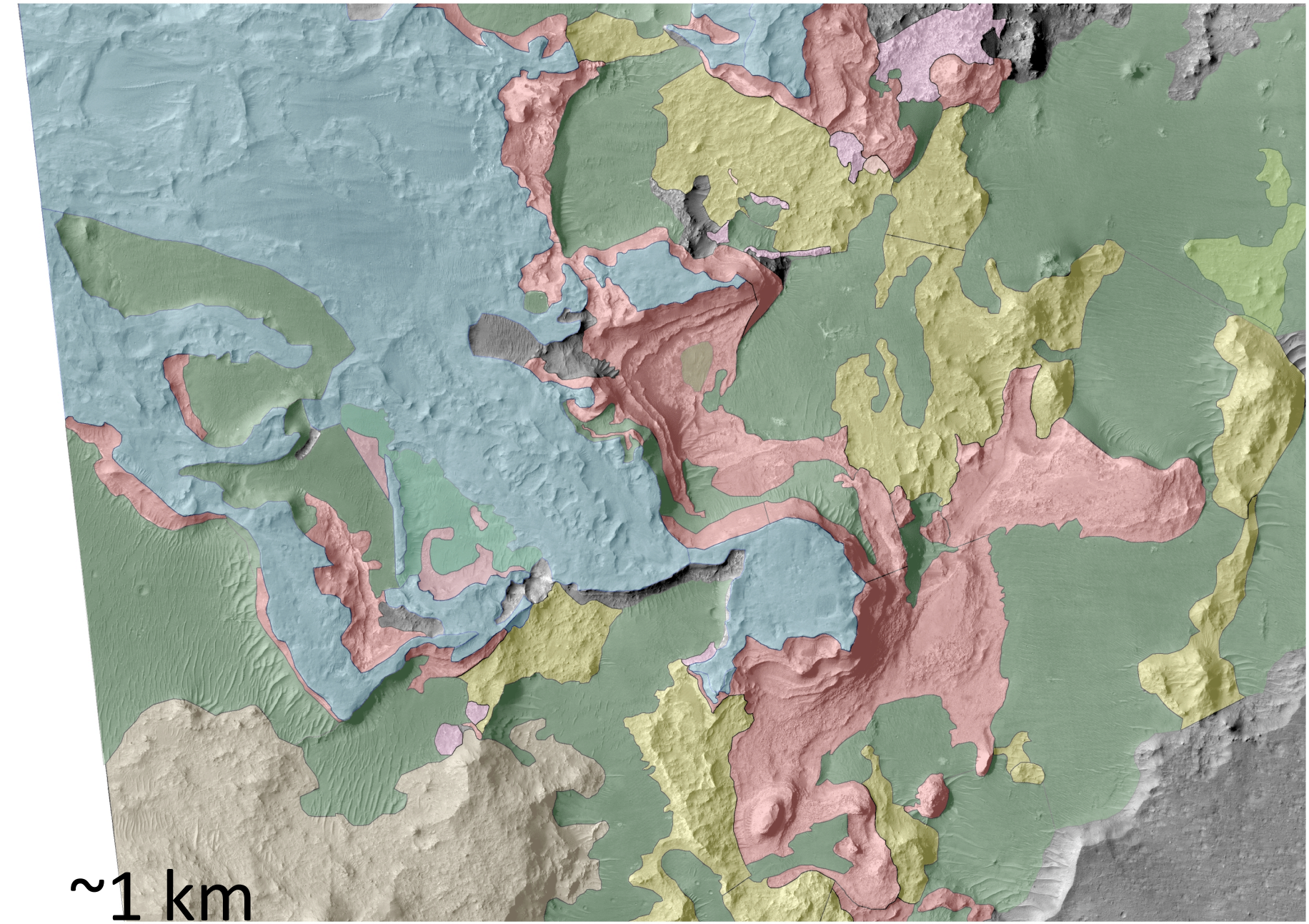

Northern Fluvio-deltaic Systems
Western delta front
Youngest
Western delta lobe
SW Fluvio-
Deltaic system

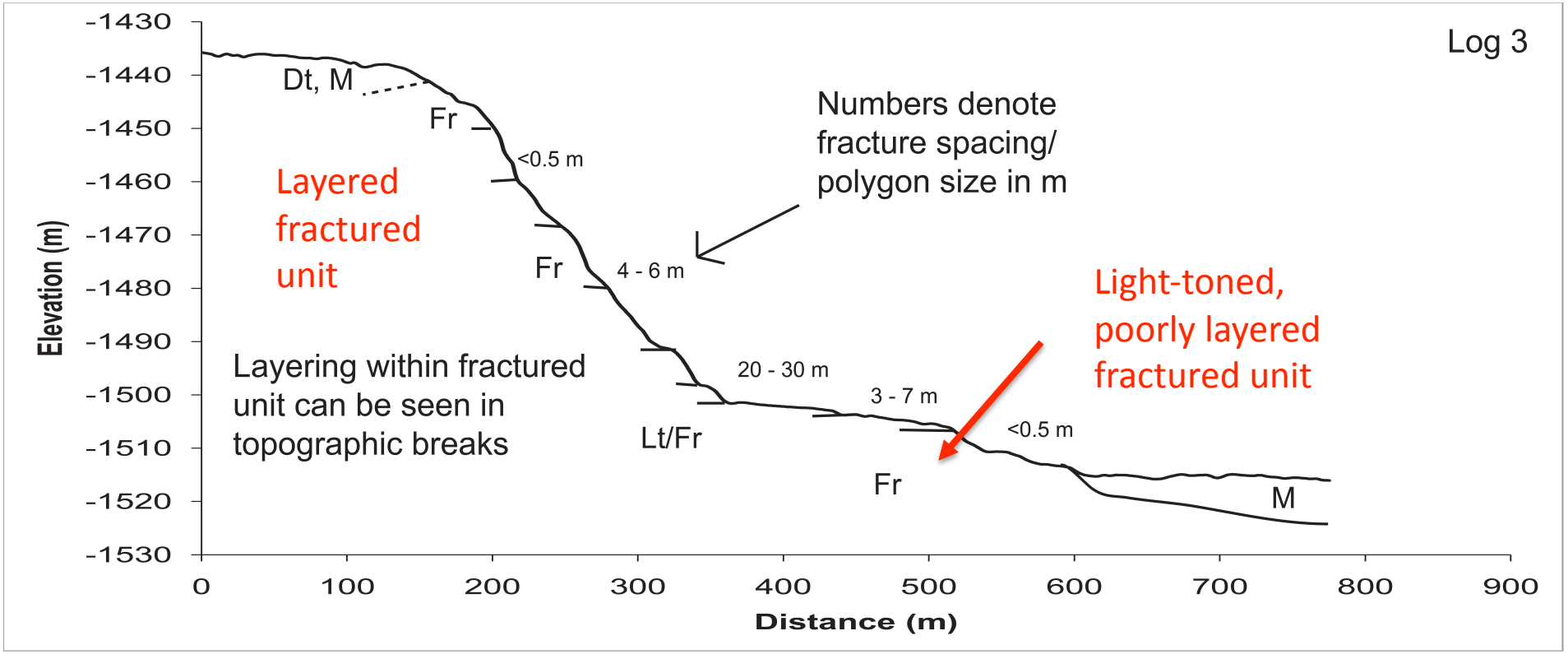
# Experimental fluvial delta evolution

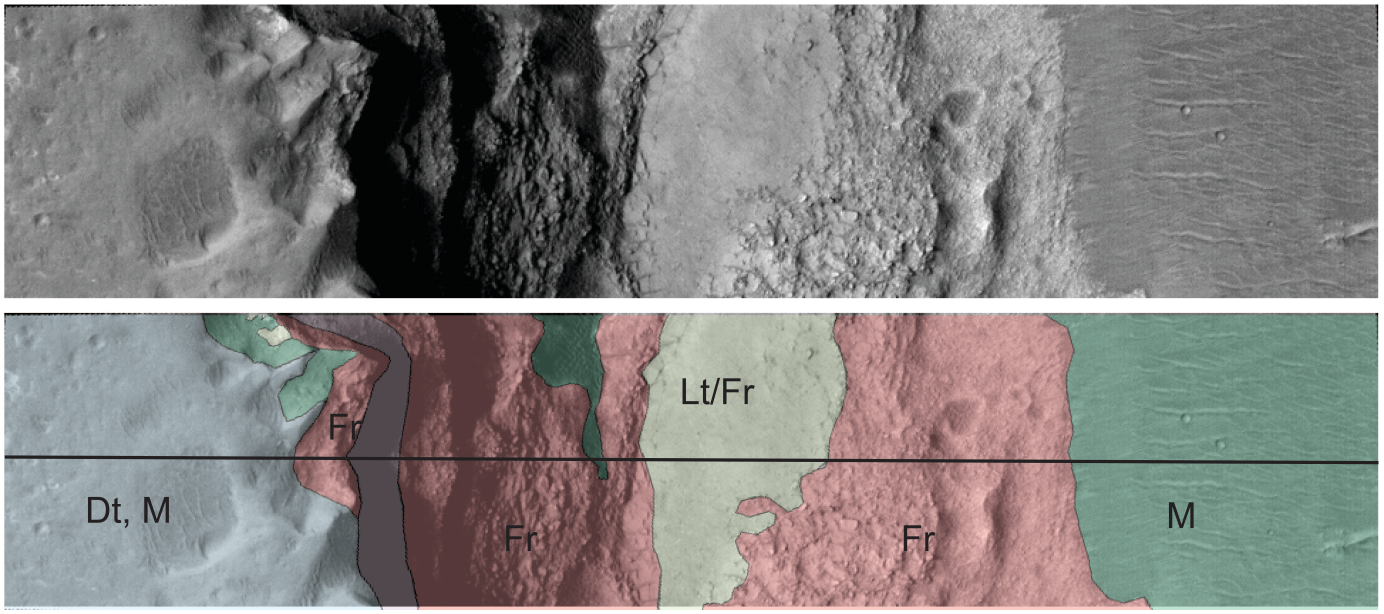


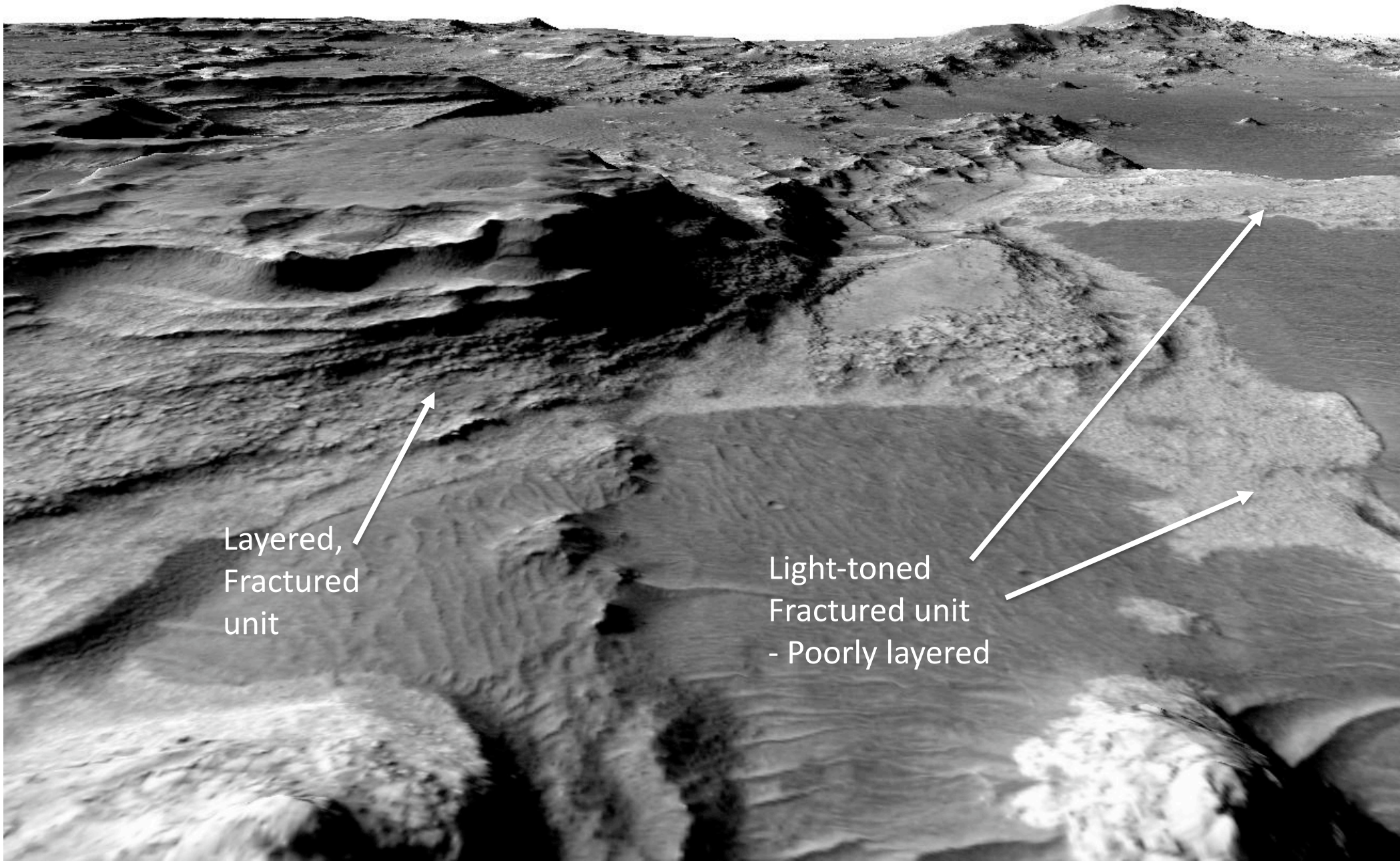

Hoyal and Sheets 2009

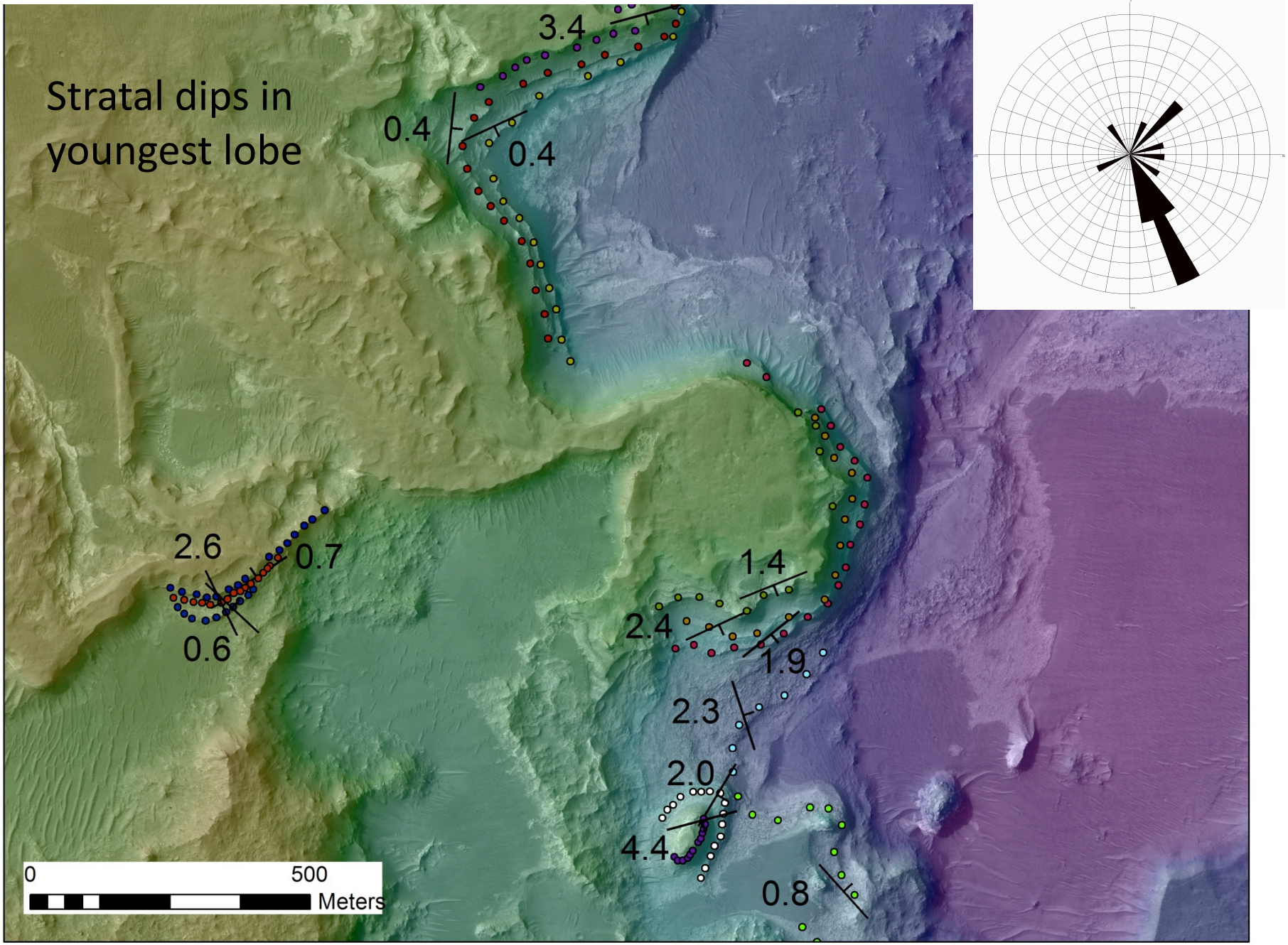

~200 m
m
-1280
-1332
-1385
-1438
-1491


~1 km

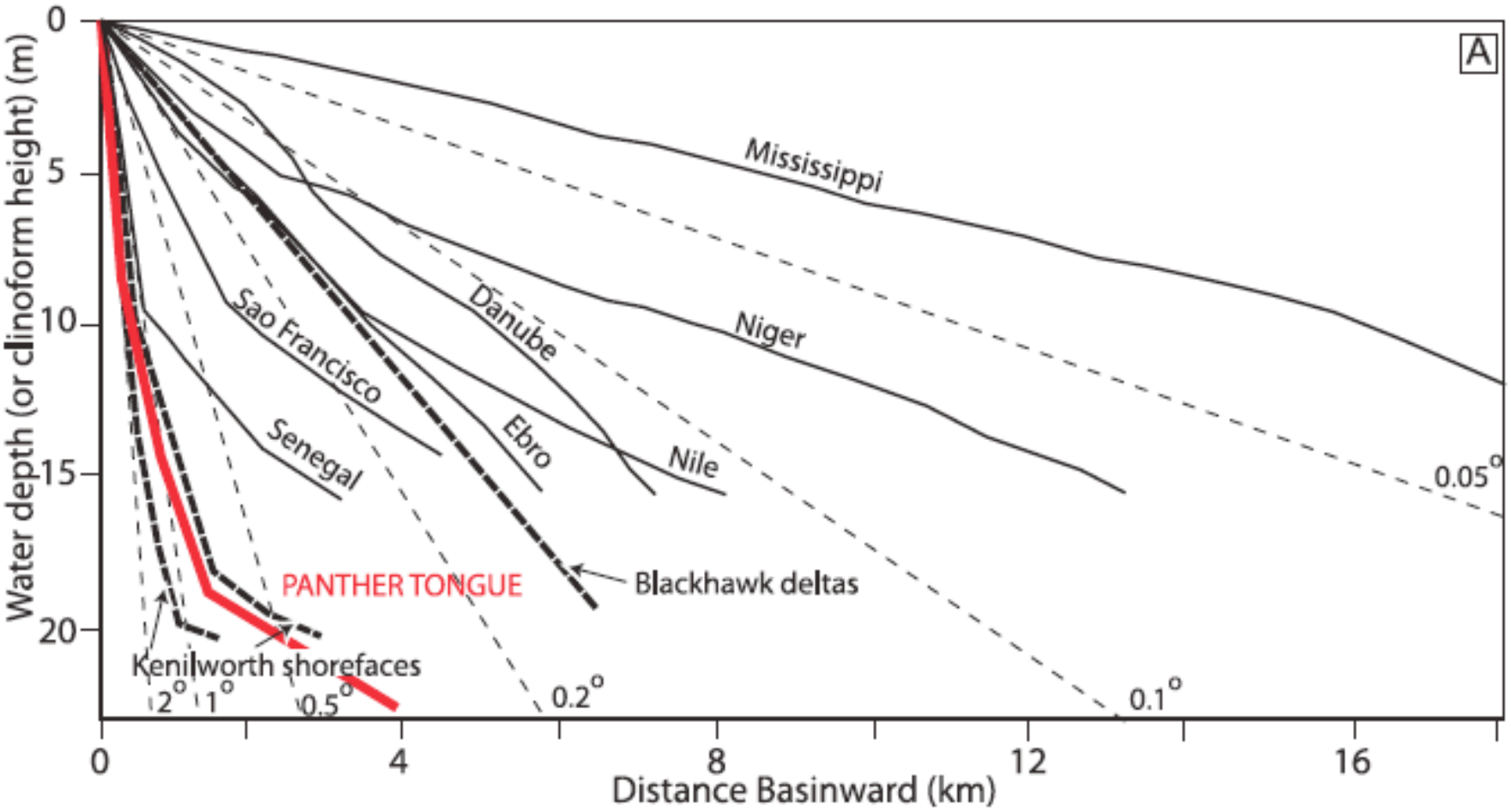

Log 3
Elevation (m)
-1430
-1440
-1450
-1460
-1470
-1480
-1490
-1500
-1510
-1520
-1530
0
100
200
300
400
500
600
700
800
900
Distance (m)
Dt, M
Fr
<0.5 m
Fr
4 - 6 m
Lt/Fr
20 - 30 m
3 - 7 m
Fr
<0.5 m
M
Numbers denote fracture spacing/ polygon size in m
Layered fractured unit
Layering within fractured unit can be seen in topographic breaks
Light-toned, poorly layered fractured unit


Dt, M
Fr
Fr
Lt/Fr
Fr
M

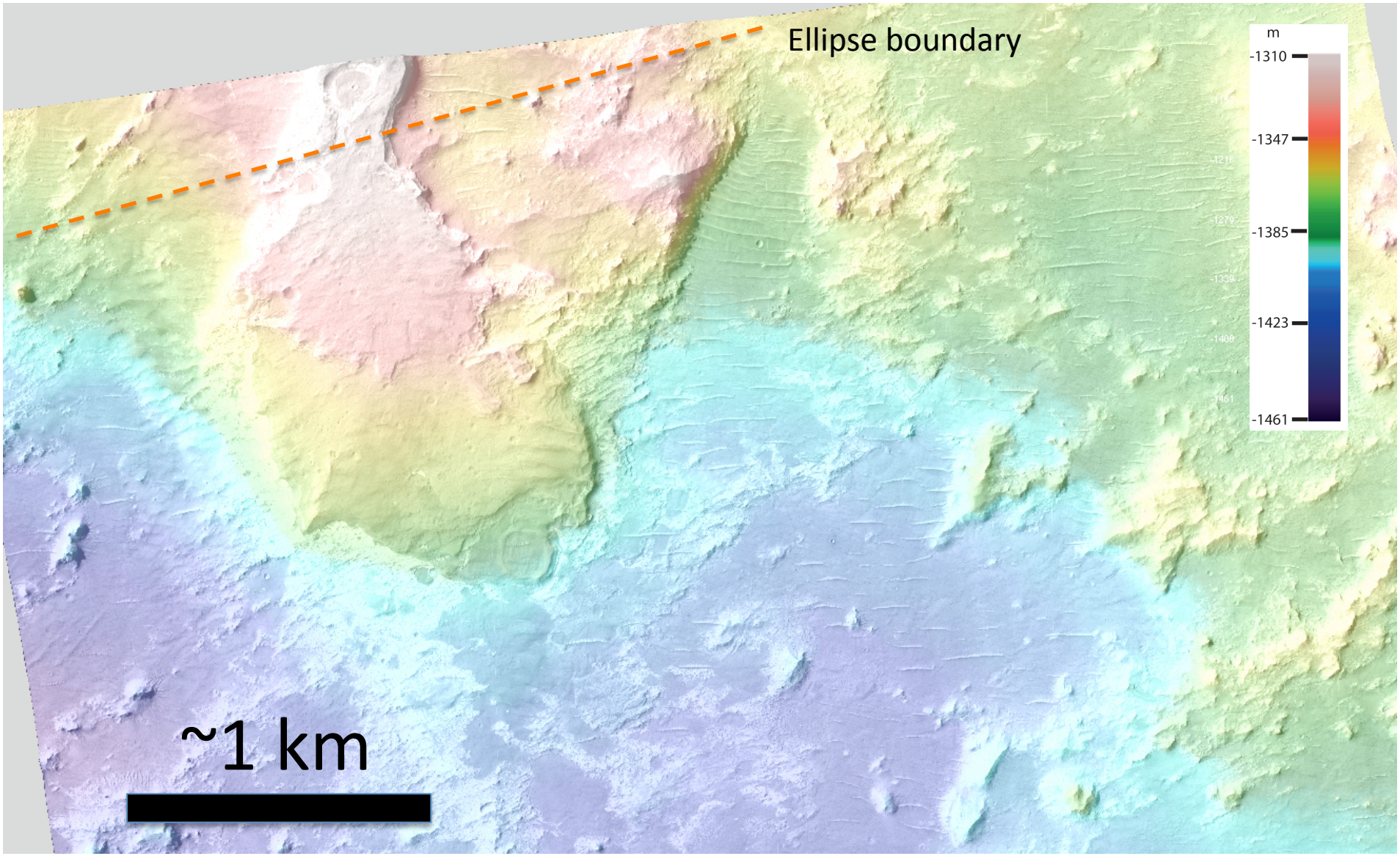

Layered,
Fractured
unit
Light-toned
Fractured unit
- Poorly layered


Stratal dips in youngest lobe
3.4
0.4
0.4
2.6
0.7
0.6
1.4
2.4
1.9
2.3
2.0
4.4
0.8
0
500
Meters

# Dips of modern and ancient Earth deltas



# North fluvio-deltaic system



# Summary

- Eberswalde has rich diversity of depositional sedimentary features that can be linked to palaeo-geomorphology.
- Sedimentary structures and architecture from MSL will provide stage for robust interpretations of process, environment and hydrology.
- Investigate chemistry and mineralogy of diverse range of rock types

# Key points

- Eberswalde offers the potential to reconstruct the hydrologic evolution of a crater lake
- Can quantify the palaeo-hydrology
- We have an environmental context to habitability

- We have the potential to sample lake beds within the ellipse